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THE EFFECT OF AGE ON NEST CONCEALMENT AND ITS COMPLIMENTARY EFFECT ON PRODUCTION OF WOOD THRUSH

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ABSTRACT.—Declines in Neotropical migratory land birds have been associated, in part, with decreases in productivity attributed to predation. Since those predators that affect offspring production may be visually dominant (i.e., avian), vegetative nest concealment was quantified for Wood Thrushes (*Hylocichla mustelina*) for fifty nests in a Delaware forest fragment in 1992 and 1993. Nest concealment was tested against age of owners (i.e., ASY vs SY) and with fledgling production. Though past studies have found an age-specific difference in per nest fledgling production, no age-specific differences in concealment were found. However, there was a positive relationship between nest concealment and fledgling output, accounting for 38% of the variation for 1992 and 19% for both years. Results from 1993 were not descriptive, since predation events were fewer. These results are consistent with the logic that the variability of predator communities in different habitats offers no adaptive strategies in nest concealment per se. However, birds may be choosing other, more holistic habitat qualities within territories which may offer greater nest concealment as a benefit. *Received 16 March 1996, accepted 20 Sept. 1996.*

Nest predation may be a major factor influencing avian reproductive success (Ricklefs 1969). Choosing the optimal nest site may be critical in habitats where predation rates are high. Additionally, parental age has been positively associated with increased reproductive performance of Wood Thrushes (Johnson 1994, Johnson and Roth, unpub. data) as well as other species (Saether 1990). Whether learned or innate, the ability to reduce predation through the concealment of nests should serve to increase fitness and be favored through natural selection, particularly in habitats where primary predators are choosing prey visually (e.g., corvids, icterids, etc.).

Some nesting criteria have been positively associated with the age of nest owners, including earlier nest initiation, greater yearly nesting attempts, and larger mean clutches (Saether 1990, Johnson 1994). However, the effect of parental age on nest site concealment has not been measured. The present study examines the effect of age on nest concealment in a migratory Neotropical, open-cup nesting species (Wood Thrush: *Hylocichla mustelina*). Past analyses have found fledgling production of Wood Thrushes to be positively associated with age (Johnson 1994, Johnson and Roth, unpub. data).

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STUDY AREA AND METHODS

The study site was a 15-ha woodlot (UDW) on the Univ. of Delaware farm in Newark, Delaware. Surrounding UDW on two sides are large fields used for agriculture; one side is adjacent to athletic fields and the other is a four lane highway. It is a relatively mature, mesic hardwood forest fragment with a mix of Coastal Plain and Piedmont elements characteristic of the Middle Atlantic Region (for more detailed descriptions, see Longcore and Jones (1969), Roth and Johnson (1993), and Gorman and Roth (1989)).

The intensive banding, mapping, and nest-monitoring protocol followed annually since 1974 (Roth and Johnson 1993) was used to provide data on location, success, and ownership of nests for the period 1992 and 1993. Ages were determined from previous banding results for returning adults and from rectrix shape for immigrants (Weinberg and Roth 1994). Nests were checked daily and timing when offspring fledged was recorded.

Potential predators of Wood Thrush eggs and young at UDW include Blue Jays (*Cyanocitta cristata*), American Crows (*Corvus branchyrhynchos*), Common Grackles (*Quiscalus quiscula*), gray squirrels (*Sciurus carolinensis*), white-footed mice (*Peromyscus leucopus*), and raccoons (*Procyon lotor*). Garter snakes (*Thamnophis sirtalis*), and black rat snakes (*Elaphe obsoleta*) are uncommon. No chipmunks (*Tamias striatus*) or flying squirrels (*Glaucomys volans*) were found. Nests which failed were investigated for indicators of predator identity (e.g., tracks, teeth marks on bands, nature of nest destruction, etc.).

Roth and Johnson (1993) attribute most of the 32% failure rate for Wood Thrush nests at UDW from 1978–1987 to predation. During the nesting period of 1992–1993, 65% of nests experienced depredation events, although only 35% were total losses (Roth, unpub. data).

Based on daily observations during the extensive monitoring of UDW, the predominant suspected predators were Blue Jays, Common Grackles, and raccoons. In order to address avian predation effects, nests which failed due to mammalian predation (torn apart), observer error, poor construction, and/or adverse weather were eliminated in the regression analyses so as to only include nests which had the potential to be affected by avian predators.

To calculate nest concealment we quantified cover around each nest, using a "density board" of clear plexiglass bearing a 3 × 4 grid of twelve 4 × 4 cm squares (Fig. 1), immediately following nest abandonment. With the grid centered on the nest and 0.5 m from it, the observer, 3 m away and at eye level with the nest, estimated the proportion of each square that was obscured by vegetation (c.g., 1.0 = totally concealed, 0.3 = ⅓ concealed, etc.). Only vegetation between the density board and the plane passing through the approximate center of the nest, parallel to the board, was considered. Measurements were recorded from the four major compass headings and from directly above the nest. The latter was accomplished using the same grid configuration mounted on an adjustable mirror. Again, as we estimated cover, the grid was 0.5 m from the nest and our eye at nest level. Concealment of each nest was the sum of all measurements at that nest. Since the intent of this study was to address concealment from avian predators, concealment from below was not considered. Since females alone build the nest (Brackbill 1958), concealment values for SY and ASY females were tested initially with a *t*-test. However, to address the possibility that males may be involved in nest site selection and since territories include vegetative characteristics which may be involved in territory selection, male age was also tested. To test if concealment affected nest success, I regressed fledgling production on concealment.

My technique logistically restricted my sampling to nests < 4 m above ground. Owners of nests < 4 m and > 4 m in 1992 and 1993 did not differ in age (females, $\chi^2 = 1.286$, df = 1, N = 113, $P > 0.25$, males $\chi^2 = 1.745$, df = 1, N = 115, $P > 0.18$).

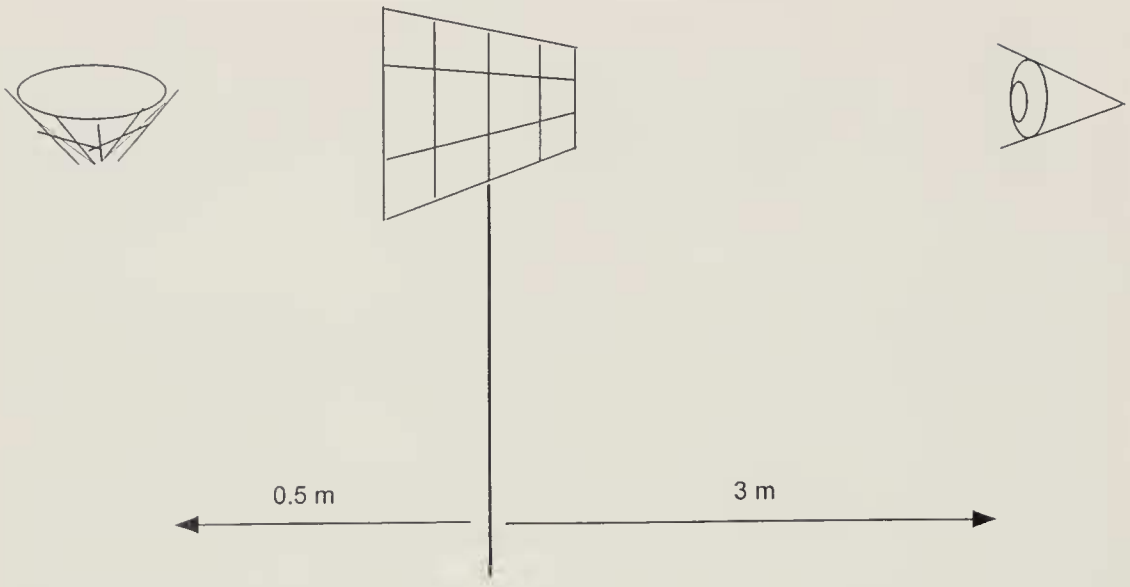

FIG. 1. Diagram of the relative position of nest, observer, and cover density board for estimating vegetative nest concealment.

RESULTS

Vegetational concealment of nests did not differ between SY and ASY females ($\bar{x}$ ASY = 28.5 ± 1.6; $\bar{x}$ SY = 27.25 ± 1.67; $P > 0.95$). Observation of pre-nesting activities (Brackbill 1958) and of multiple use of same nesting sites for territorial males coupled with different females (M. Johnson, pers. obs.) have provided circumstantial evidence that males may influence female nest site selection. As with females, no age class differences were found ($\bar{x}$ ASY = 25.60 ± 1.30; $\bar{x}$ SY = 27.13 ± 1.27; $P < 0.16$). These comparisions included all nests regardless of outcome.

Though there were no relationships between age of parent and nest concealment, a benefit of greater fledgling productivity may be realized from nests with greater concealment. Linear regression of fledgling production on total concealment explained 19% of the variance ($r^2 = 0.19$, df = 49, $F = 11.066$, $P < 0.01$) of those nests which could be potentially affected by avian predators (see Methods). Nests constructed in 1992, however, yielded a stronger relationship between concealment and production where nest concealment explained 38% of the variance ($r^2 = 0.38$, df = 27, F = 15.61, $P < 0.01$). No such relationship was found for nests in 1993 ($r^2 = 0.08$, df = 21, F = 1.653, $P > 0.21$), when overall failure rates were lower (Johnson 1994).

DISCUSSION

If nest site selection is closely tied to fitness, given its effect on fledgling production, then the ability to select well-hidden sites should be

common where visual predators predominate. Decreases in residual reproductive value have been hypothesized as a mechanism for innate age-specific dominance in reproductive effort for older birds. Moreover, if there are age-specific differences in territory acquisition (e.g., Sherry and Holmes 1989, 1990), then the optimal nest sites that are within these selected territories should be used predominately by older birds. Given the predator composition, structural heterogeneity of the understory, and previous failure rates of Wood Thrush nests at UDW (Roth and Johnson 1993, Johnson 1994), it is reasonable to assume that older birds would conceal their nests more than yearlings. I found no evidence that this was true.

The effect of experience has been observed to enhance foraging success (Desrochers 1992) and reproduction in birds (Pyle et al. 1991). Likewise, an age-specific difference in nest concealment seems reasonable if birds learn from previous avian predation events. Qualitative observations of individuals suffering suspected avian predation losses did not consistently result in birds subsequently choosing more greatly concealed sites nor did the data reflect this logic.

Given the evidence (i.e., predator community structure, vegetational heterogeneity, Wood Thrush response to Blue Jays and Common Grackles around nest site (Johnson 1994), witnessed events, and post predation evidence), avian predation may be a strong regulating force on fledgling production of Wood Thrushes at UDW. Westmoreland and Best (1985) attribute 79% of the nest failures to avian predation, and Yahner and Delong (1992) attribute 90% of unsuccessful nests in a Pennsylvania woodlot to avian predators. Additionally, Hoover et al. (1995) attribute most of the Wood Thrush losses to the same suspected avian predators in several Pennsylvania forests. Therefore, there should be a clear overall advantage to concealing nests from visually oriented predators. In 1992, the data reflected this advantage. In 1993, there was no association. However, during this period, failure rates (and therefore predation events) were lower (Johnson 1994). In this light, any clear advantage of nest concealment would not have been apparent.

Nest concealment may be less important where predator communities are different or where vegetational structure selectively permits predator access. The plant species most frequently used by Wood Thrush in UDW is *Viburnum dendatum* (Roth, unpub. data), which cannot easily support the weight of larger mammalian predators present at UDW. In habitats where *Viburnum* or structurally similar understory is not present, mammalian and reptilian predation may be an important factor. These pressures may be variable in time as well as space and be such to offset or modify the selective advantage of concealment. Further, other factors such as

microclimate, food abundance, shrub density, as a host of multiple nest patch factors, may additionally be instrumental in nest site selection (Holway 1991); vegetation density may be only highly correlated with these attributes.

A stronger relationship between male age and concealment might have been found had I quantified the vegetation structure of the nest patch. Previous data from UDW and from other studies have shown older birds to breed in superior habitats more often than yearlings (Sherry and Holmes 1989, 1990, Johnson 1994). Greater concealment may be a circumstance of greater nest patch vegetation than nest site vegetation per se. Greater vegetation in the entire nest area may hold a greater advantage in concealment of adult movements to and from the nest as well as yielding a greater probability of nest concealment from sheer random nest placement within the nest patch. In addition, it must be noted that cryptic nest placement would not be measured in these analyses, as only vegetation actually concealing the nest was measured.

My data suggest that concealment of the nest can be advantageous through lower probability of avian predation. However, the selective advantage of greater nest concealment by experienced birds was not evident in this population of Wood Thrush.

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